

# Thermal Energy Storage

Thousands of Peak  
Megawatts for Texas

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# **Thermal Energy Storage Benefits Texas**

- THOUSANDS of Peak MW's can be recovered in Texas with Thermal Energy Storage (TES)
- Prior to de-Regulation TES was widely deployed
- A market transformation program for TES needs to be adopted to break down market barriers created by de-regulation

# Energy Storage Concept

- Energy is stored during “off-peak” periods, then distributed during “peak” periods.
- Examples of energy storage systems:
  - Batteries in a mobile phone
  - The human body
  - Thermal Energy Storage (**TES**)





# Commercial / Industrial TES System

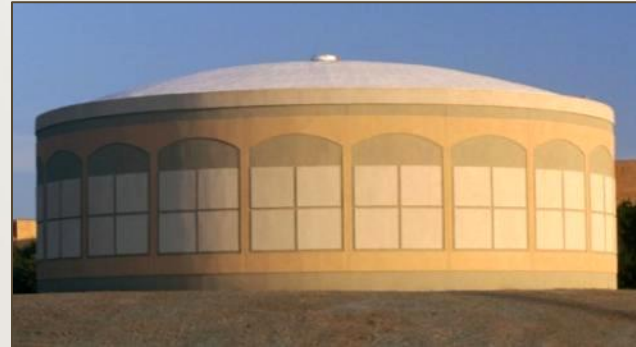
## Ice Storage

- Energy in an ice phase
- Relatively small footprint, ideal for urban applications



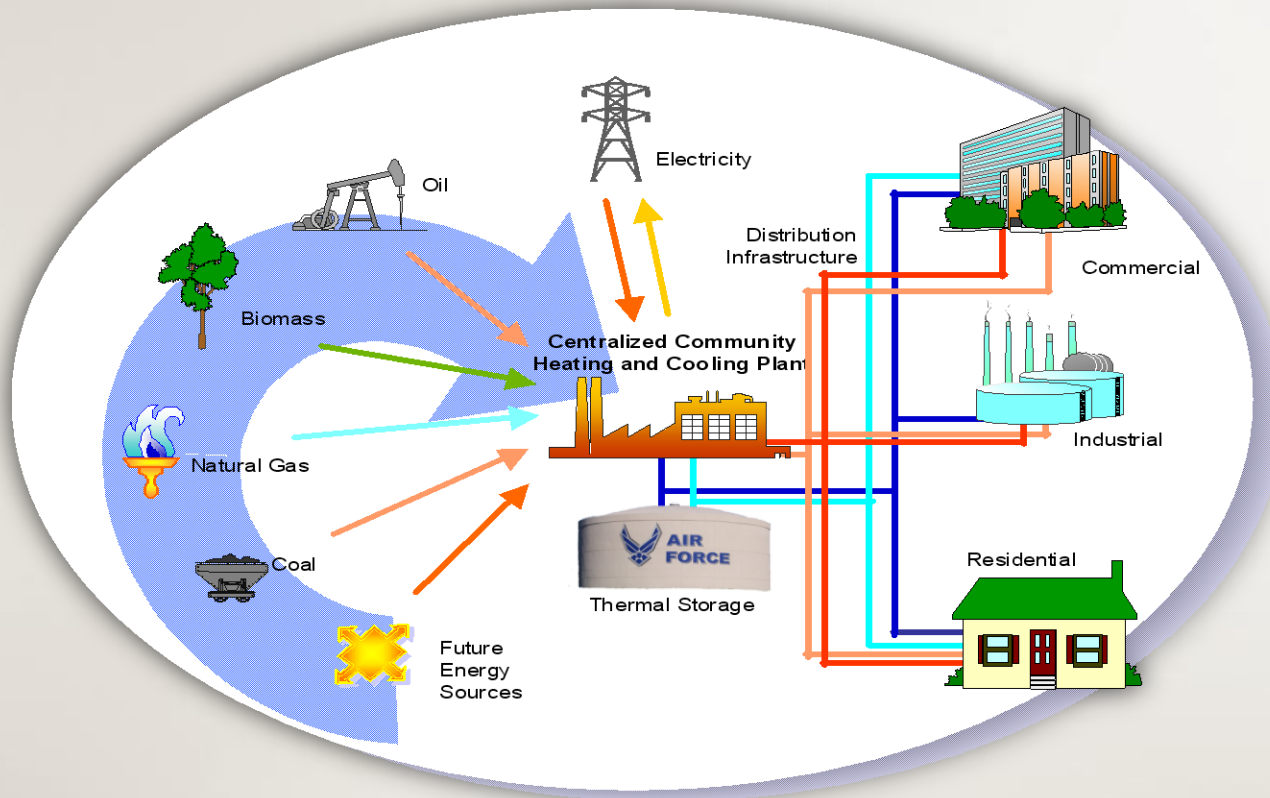
## Chilled Water

- Energy in the chilled water liquid phase
- Economical in larger applications



Like BIG “rechargeable batteries”

# TES with Chilled Water District Cooling Systems



# TES - Proven Technology in Texas



Edinburg, TX UT – Pan Am



San Antonio, TX - Alamo HS



Lackland AFB, TX



San Antonio, TX - Airport



San Antonio, TX – Microsoft



Houston, TX – Reliant

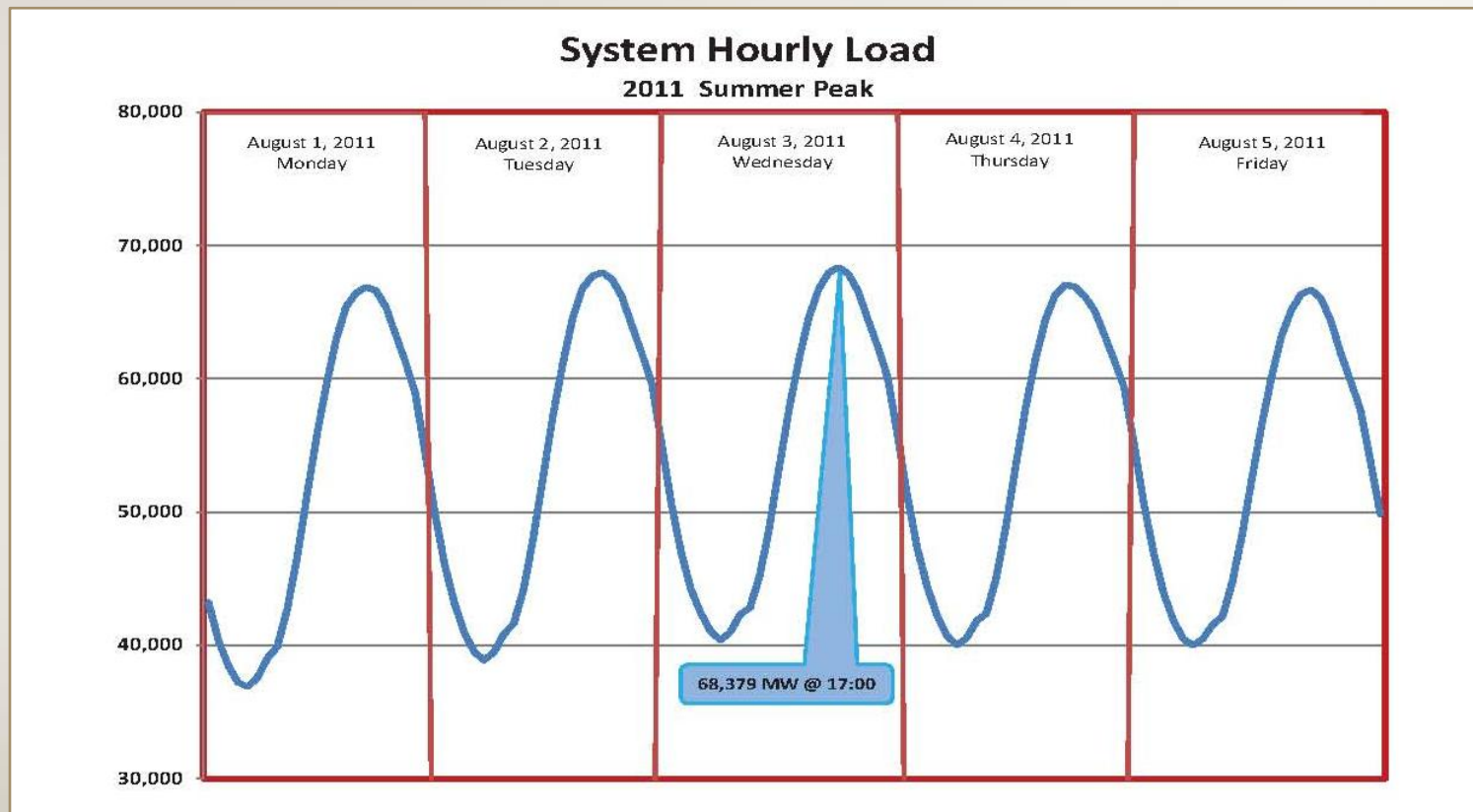
**COLLEGE AND  
SCHOOL  
CAMPUSES**

**GOVERNMENT &  
MUNICIPALITIES**

**PRIVATE INDUSTRY  
& DATA CENTERS**

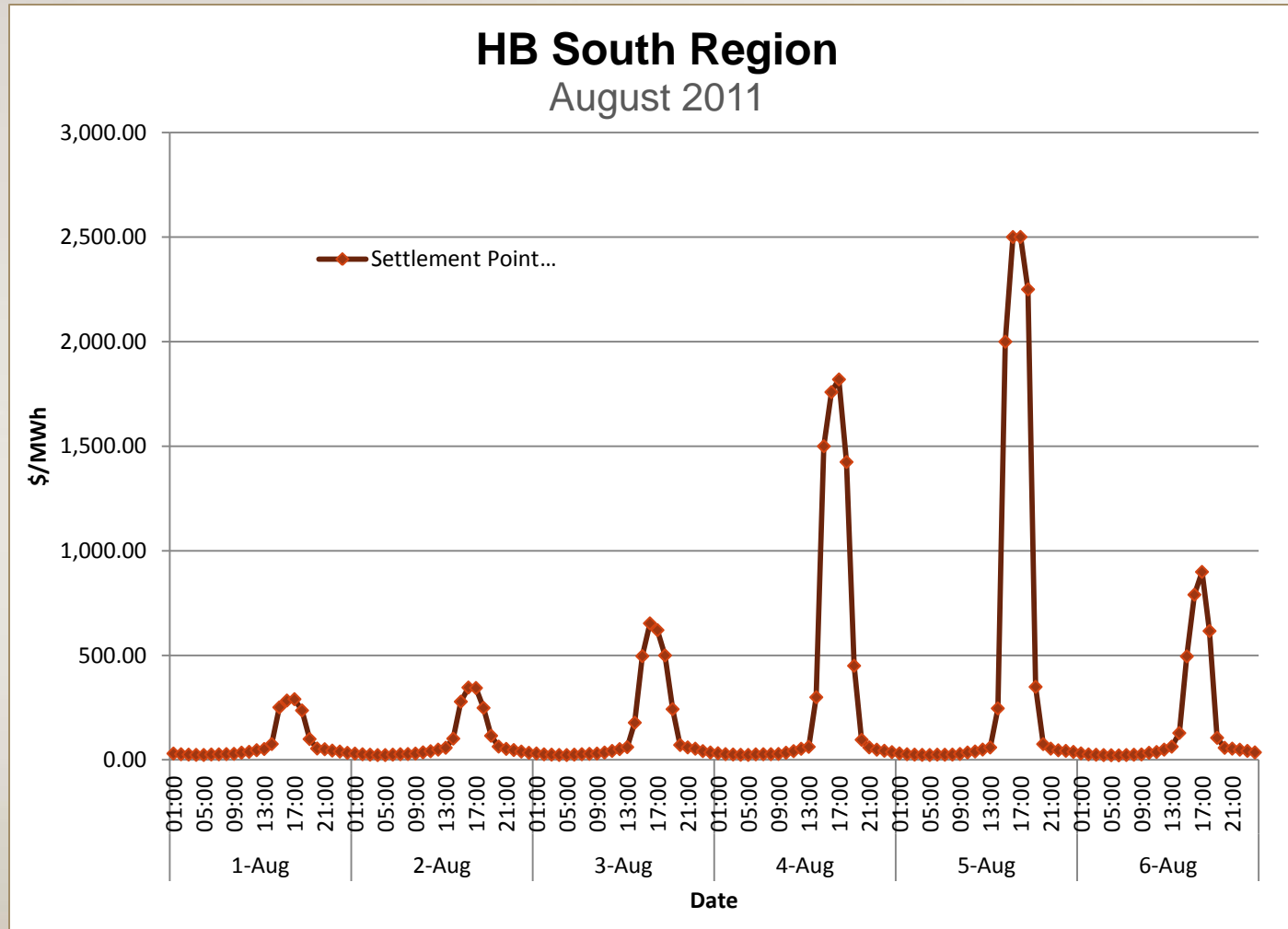
***PROVEN AND COST-EFFECTIVE***

# ERCOT Grid - Hourly Load



Source: ERCOT, [www.ercot.com](http://www.ercot.com)

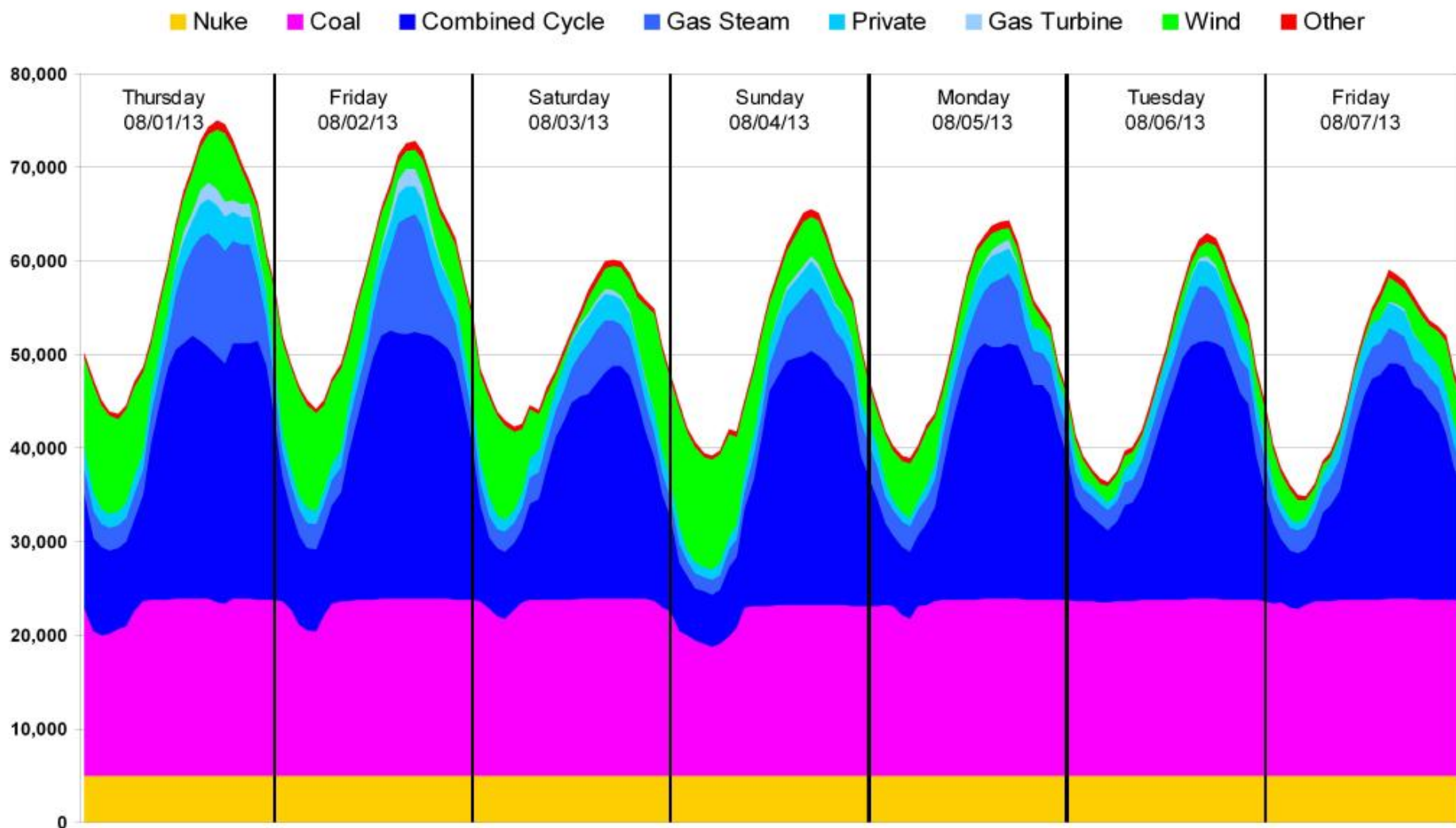
# ERCOT Grid - \$/MWh



Source: ERCOT, [www.ercot.com](http://www.ercot.com)



# 2013 Peak Load Week - Generation by Fuel Type



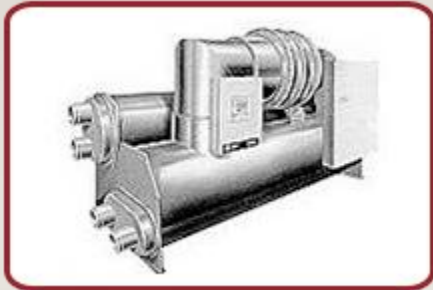
Note – no changes to existing reserves requirements were assumed for this analysis

# Applicability

- PUCT recognizes peak is due mostly to HVAC
- Nighttime generation is efficient and plentiful
- Cooling at night to cool buildings or boost generation efficiency can help manage peak summer demand and intermittency issues from renewable energy

# Electric Peak Reduction

- 0.6 MW



– 1,000 Ton Chiller

- 0.0 MW

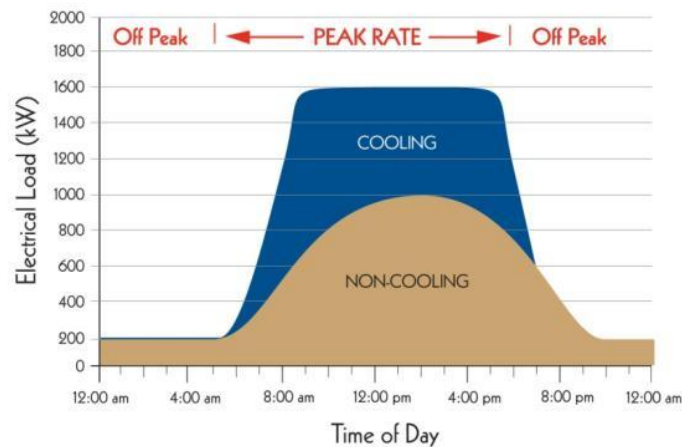


– TES Tank

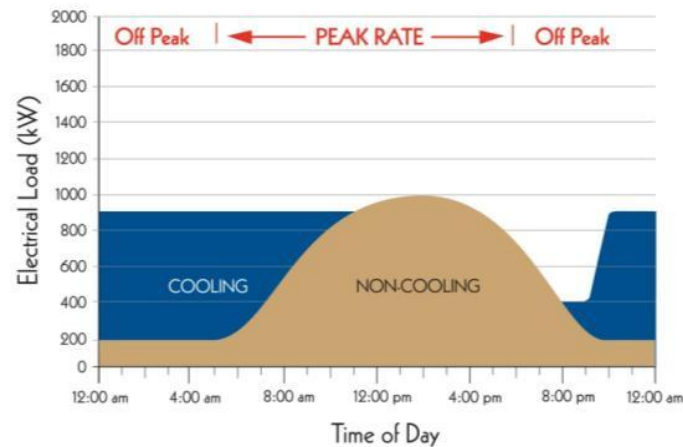
By utilizing a TES tank and the excess capacity of a chiller plant at night time, the electric chillers and associated equipment could be de-energized during the peak period.

# Electric Load Profile

LOAD PROFILE **WITHOUT** TES



LOAD PROFILE **WITH** TES



## With TES:

- permanent electric load shift from peak periods to off-peak periods
- energy reduction by taking advantage of cooler ambient conditions at nighttime and running chillers at their optimum conditions



# **Thermal Storage Benefits utilities, environment, rate payers and users!**

- Affordable solution to reduce peak summer demand
- Reduce source energy consumption
- Reduce cooling costs for rate payers
- Storage systems can optimize HVAC systems and improve efficiency
- Prepares owners for Demand Response programs
- Enhance the renewable energy goals by increasing their output and their ROI

# Thermal Energy Storage Provides:



**Low Operating  
& Life Cycle  
Costs**

**Reduced  
Source Fuel  
Consumption  
& Emissions**

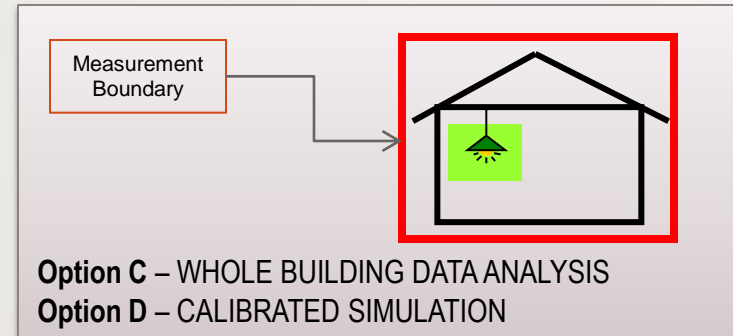
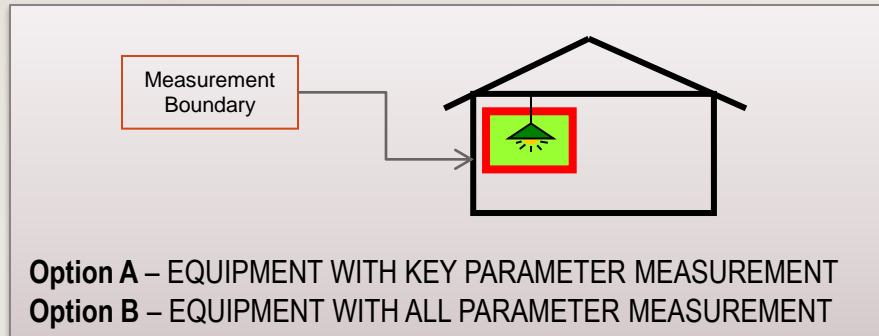
**Energy  
Transformation  
& Demand  
Response  
Ready**

# Barriers to Grow TES Market in Texas

- **TES Myths from Years Ago**
  - Complicated and expensive
    - Read Energy Storage Myths, from *ASHRAE Journal*, September 2003.
- **Knowledge about TES Technologies**
  - Much has changed including better products, best practices, and controls, but information has not been widely distributed
- **Electricity Rates and Confusion**
  - Rates that support storing energy are sometimes dismissed
  - Rate confusion leads to unfavorable life cycle cost modeling
  - Lack of historical rate information leads to inaction
- **Inconsistent Utility Signals or Lack of Promotion of TES**
  - Leads to market confusion and inaction
  - Missing significant incentive

# Measurement & Verification Method and IPMVP

Compliant with International Performance Measurement & Verification Protocol

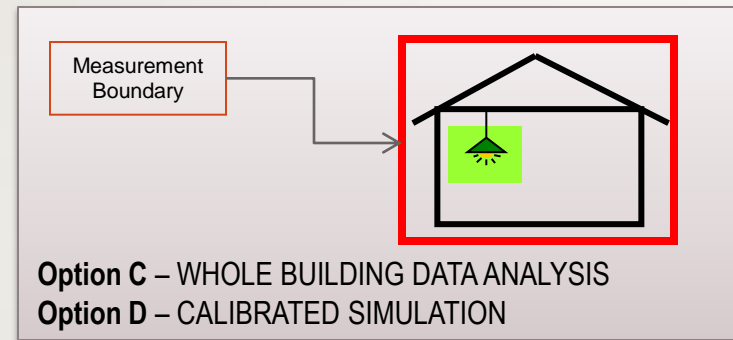
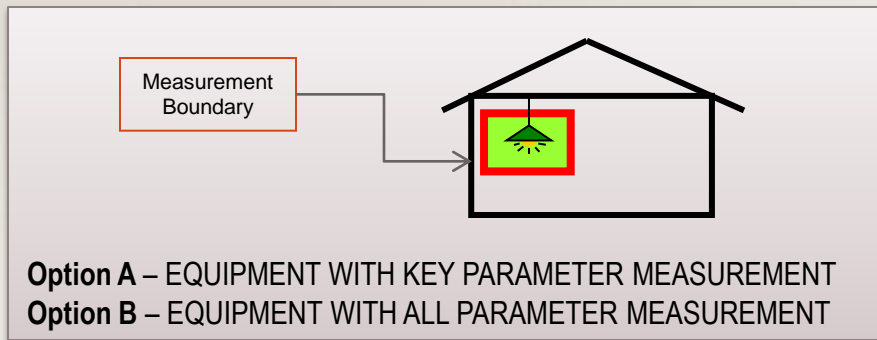


- Option B typically used – measuring all parameters of relevant equipment
- Measurement & Verification documents efficiency and/or cost avoidance savings
- Facilitates remote monitoring, automated data collection



# Measurement & Verification Method and IPMVP

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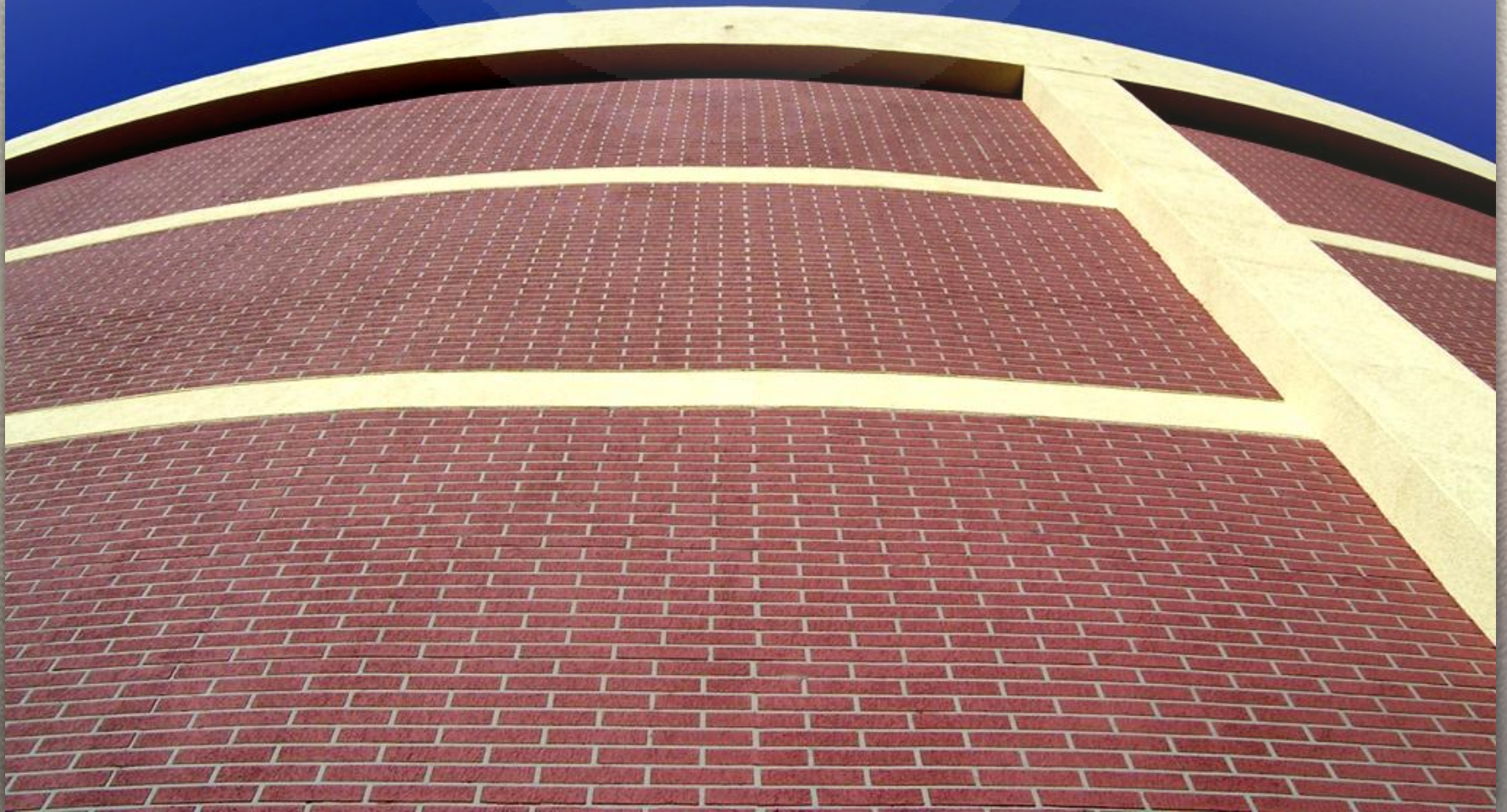
- Early identification, isolation & resolution of issues with post-installation reporting
- Regular spot checks and continual communication of performance
- M&V involved throughout project development, implementation, and performance period

# Texas Needs Thermal Energy Storage

- Utility Efficiency Programs should include a Market Transformation Program to help reinvigorate market adoption of TES
- We are working with Retail Electric Providers to encourage offerings of rates to recognize the value of TES
- TES associated with a chiller at a gas turbine plant would provide double benefits and a 5X capacity benefit:
  - Chilled inlet air for gas turbines increases the operating capacity by 5 times that of the power needed to run the chillers
  - The TES shifts the chilling to off-peak, removing the parasitic load, and allows the chilling system to run more efficiently during cooler ambient conditions at night



## QUESTIONS & ANSWERS





# **Case Study # 1**

Demand Side



# San Antonio, TX - Lackland AFB

## Scope of Work:

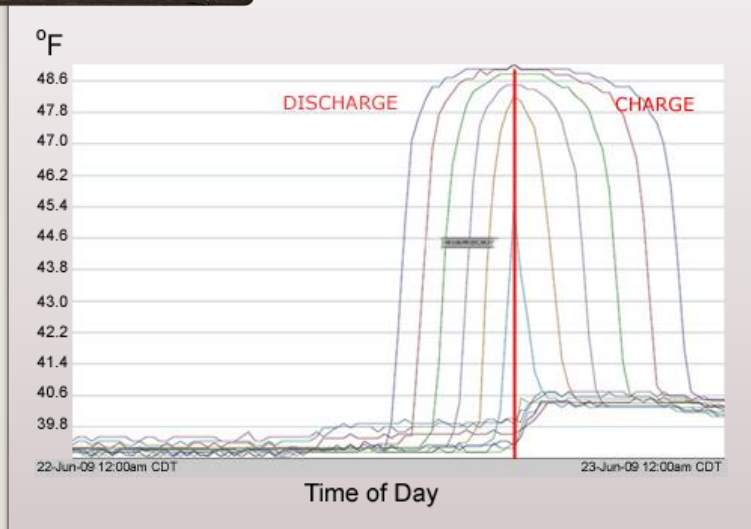
- 0.79 MG TES tank added to one of the chilled water district cooling systems
- Chilled water control strategy that takes advantage of off-peak electric rates



# San Antonio, TX - Lackland AFB



Figure 1 CHW Stratification Chart



## Project Results:

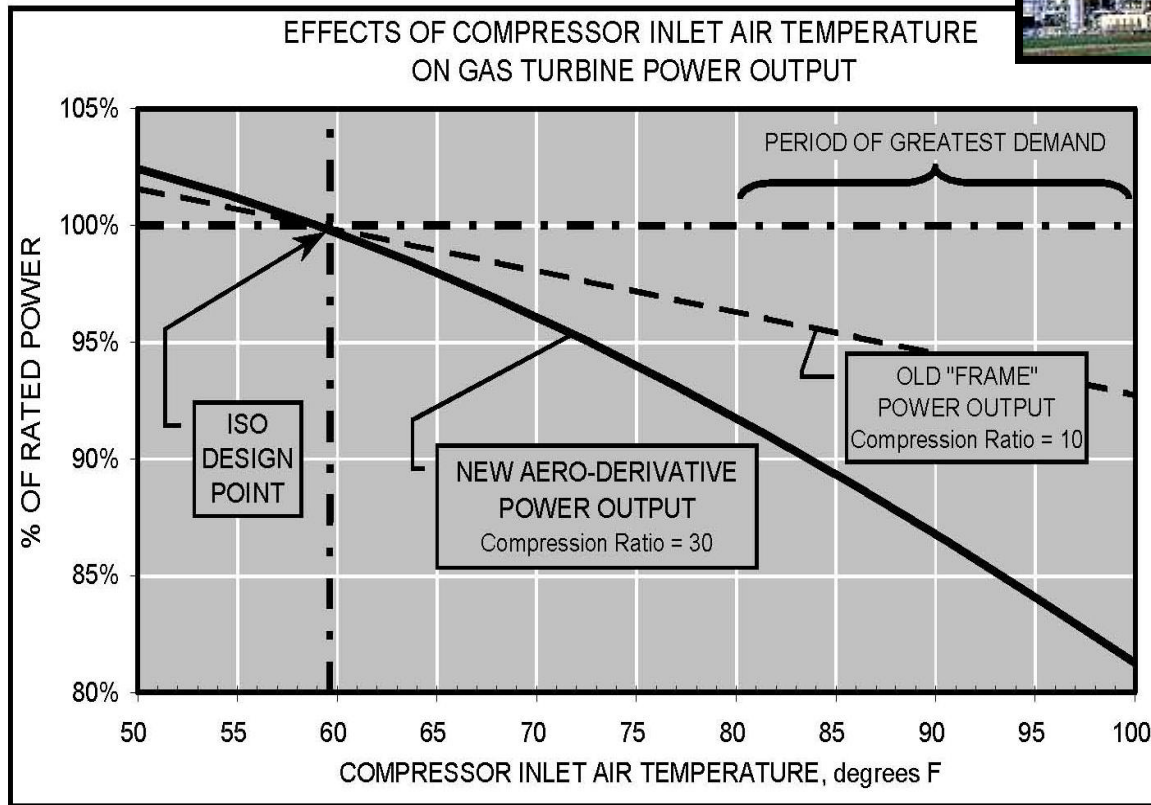
- Electric load shift of almost 1 MW

# **Case Study #2**

Supply Side



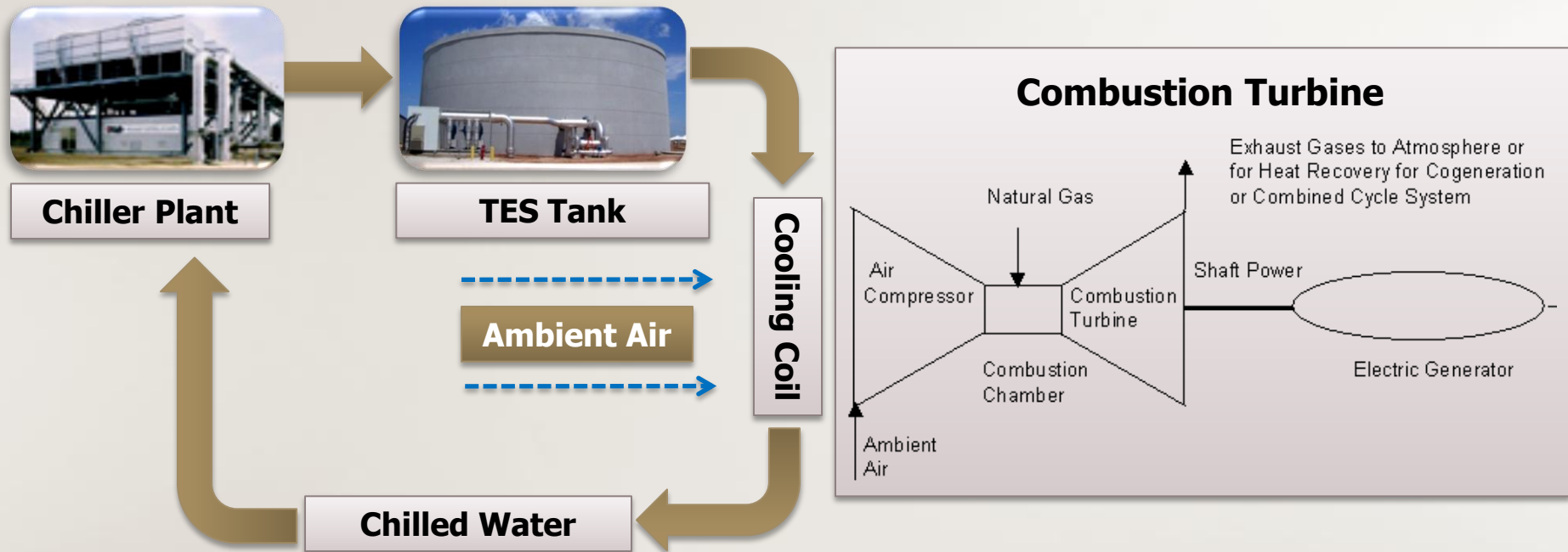
# Natural Gas Power Plant Performance



**Performance goes down as outside air temp goes up**



# Turbine Inlet Chilling Improves NG Power Plant Performance



# Cleburne, TX - NG Power Plant

## Scope of Work:

- Retrofit existing **SGT6-5000F (501F)** combustion turbine with an inlet chilling system:
  - New 1.74 MG TES tank
  - New 3,800-ton modular CHW plant with cooling coils & energy management system



Coil Retrofit

Chiller Package

TES Tank

# Cleburne, TX - NG Power Plant

- Power Plant Performance:  
Before - **227 MW @ 95°F DB / 75°F WB**  
After - **266 MW @ T2 of 50°F**  
Net - **37.5 MW (16.6% Increase)**



***Over 2,400 MW of Potential in Texas***